REMARKS

Claims 1-37 are pending in the present application. In the Office Action of February 11, 2003, the Examiner objected to the drawings as failing to comply with 37 CFR 1.84(p)(5). The Examiner rejected claims 1-5, 7, and 18 under 35 U.S.C. §102(c) as being anticipated by Wang (USP 5,928,148). Claims 1-8, 11, 12, 18, and 21-23 were rejected under 35 U.S.C. §102(b) as being anticipated by Yoshitome Japanese Laid-open Patent Application (kokai) No. H6-311977. Claim 10 was rejected under 35 U.S.C. §103(a) as being unpatentable over Yoshitome Japanese Laid-open Patent Application (kokai) No. H5-95927. Claims 9, 13-17, 19, 20, 22, 28-30, 32-35, and 37 were rejected under 35 U.S.C. §103(a) as being unpatentable over Yoshitome, H6-311977. Claim 31 was rejected under 35 U.S.C. §103(a) as being unpatentable over Yoshitome, H6-311977 in view of Wang. Claim 36 was objected to as being dependent upon a rejected base claim.

Objection to Drawings:

Regarding the Examiner's objection to the drawings for failing to comply with 37 CFR 1.84(p)(5), the Examiner stated that "paragraph 20 component 16 is identified as a "display" and then in the next sentence component 16 is identified as a "display." However, Applicant believes the Examiner intended to state that in paragraph 20, component 16 is first identified as a "display" and subsequently, component 16 is identified as a "screen." The Examiner correctly identified an error. As such, Applicant has amended paragraph 20 to state that component 16 is a "display."

The Examiner then objected to Fig. 2 because "Figure 2 shows a component 114, which is not mentioned in applicant's description. However, paragraph 28 of Applicant's Specification *does* mention component 114. However, Applicant has amended paragraphs 27 and 28 of the Specification to clarify that component 112 is the slab thickness and component 114 is the volume of interest or slab.

Rejections under §112:

The Examiner rejected claim 34 for insufficient antecedent basis for the limitation "a magnet of the MR system." Accordingly, Applicant has amended claim 34 to state that the maintained position of slab thickness is fixed, relative to a magnet of the "medical image scanner." As such, Applicant believes the rejection is traversed.

Claim Objections:

The Examiner objected to claim 2, "as being of improper dependent form for failing to further limit the subject matter of a previous claim." Specifically, the Examiner asserts that "exciting and encoding spins to restrict excitation to the selected slab thickness" is already recited in the independent claim, claim 1. However, claim 1, in part, calls for "exciting and encoding spins to acquire data that is restricted to the selected slab thickness." That is, the cited element of claim 1 calls for restricting the acquired data, whereas the cited element of claim 2 calls for restricting the excitation. One of ordinary skill in the art will readily recognize that restricting the acquired data to the selected slab thickness is not the same as restricting the excitation to the slab thickness. Accordingly, claim 2 is in proper dependent form because it further defines the subject matter of claim 1.

The Examiner also objected to claims 13 and 19 because of informalities. Regarding claim 13, the Examiner asserts that "the claim as written is unclear." The Examiner states that Applicant calls for a slab-selective RF pulse to restrict the excitation and then states "(i.e. of what?)." Claim 13 is dependent upon claim 2. It is noted that claim 2 further defines the step of exciting and encoding spins *as restricting excitation to the slab thickness*. Claims 13 further adds the step of "applying a slab-selective RF pulse *to restrict the excitation...*" Accordingly, when reading claim 13, with its dependent claim 2, the claim is in proper form and is not unclear.

The Examiner objected to claim 13 on an additional basis. The Examiner states that "if applicant means that the 'slab-selective RF pulse' has 'linear phase, sharp transitions, and low slice ripple...[t]his feature needs to be more clearly stated, otherwise the features could correspond to the feature of restricted excitation." Applicant has

amended claim 13 for clarification. Accordingly, Applicant requests withdrawal of the objections to claim 13.

The Examiner also rejected claim 19 "because the words 'and are' in this claim are grammatically confusing." As such, Applicant has amended claim 19 for clarification.

Background Remarks:

Before addressing the specific elements and language of the claims, Applicant would like to take the opportunity to highlight some terminology and concepts fundamental to medical imaging in order to avoid further rejections based upon misinterpretation of terms that are well known in the art. Claim language must be interpreted in light of Applicant's own Specification and if Applicant did not define the term, claim language must be given plain meaning as would be interpreted by one of ordinary skill in the art. MPEP §2111.01.

One of ordinary skill in the art will readily recognize a fundamental difference between that which is referred to by the terms "region of interest," "FOV," "optimal imaging area," "imaged area" or "imaging volume," and "slab" or "slab thickness." That is, the terms have distinct definitions within the art and are not interchangeable. One of ordinary skill in the art will readily recognize that the "region of interest" is the overall area of the subject to be imaged, which may or may not require multiple FOVs to image. For example, Wang et al. teaches the use of three FOVs for imaging a "region of interest" from foot to torso. *See* Wang et al. Fig. 3. Wang et al. identifies that "[t]he *field of view (FOV)* in MR imaging is limited by the volume of the B_o field homogeneity and the receiver coil size (typically, the FOV<48 cm on current commercial MR scanners." Col. 2, lns 26-30, emphasis added. Wang et al. continues by stating that "[t]he anatomical *region of interest* in the lower extremity, for example, is about 100 cm and this requires several FOVs, or stations, for a complete study." Col. 2, lns 30-32, emphasis added. Therefore, one of ordinary skill in the art will readily understand that "FOV," or "field of view," refers to the specific area imagable by the imaging device at a specific time, e.g. Wang et al. teaches FOV 1 for the area from foot through calf. *See* Wang et al. Fig. 3,

Component 250. The "optimal imaging area" or "optimal imaging volume" is the spatial volume with optimal gradient linearity, B_o and RF homogeneity. *See* Applicant's Specification, paragraph 4. The "Imaged area" or "imaging volume" refers to the area actually imaged, which may also require multiple FOVs and may be larger than the "region of interest" to ensure the "region of interest" is adequately imaged. Finally, a "slab" or "slab thickness," as clearly stated in Applicant's Specification, can be smaller than the FOV and the imaging area so that the table may be moved to cover a desired FOV while the slab position remains fixed relative to the magnet in the MRI system. *See* Applicant's specification, paragraphs 7, 8, and 25. However, since Applicant's specification explicitly states that the slab *is* smaller than the FOV and the imaging area, the Examiner is required by MPEP § 2111.01 to interpret "slab" as Applicant has defined the term, i.e. smaller than the FOV and the imaging area. Id. Therefore, one of ordinary skill in the art will understand "region of interest," "FOV," "optimal imaging area," "imaged area" or "imaging volume," and "slab" or "slab thickness" to have specific definitions that are not interchangeable.

However, contrary to the specific definitions of the terminology explained above, the Examiner has mistakenly understood these terms to be interchangeable or equivalent. As such, the Examiner has rejected the claims of the current invention based on this mistaken understanding.

Furthermore, Applicant believes it beneficial to correctly synopsize Wang et al. to correct the Examiner's misconceptions regarding the teachings of Wang et al. Simply, Wang et al. teaches a method of MR imaging over a large region of interest by using multiple FOVs. *See* Wang et al. Col. 2, lns. 22-50. Wang et al. teaches the use of table stepping to move between the multiple FOVs. Id. Therefore, Wang et al. teaches an example of a system that the present application improves upon. Applicant states in the Background:

> In such MRI systems, the volume for acquiring MR data with optimal gradient linearity, having a uniform magnetic field B_o, and uniform radio frequency (RF) homogeneity is of limited extent. Desired fields-of-view (FOV) that exceed this limited volume are traditionally acquired in sections, with table motion between scans. The resulting concatenated images often exhibit discontinuities at the slab

> junctions. These slab-boundary artifacts result in non-ideal images. When these artifacts are either severe or occur in a critical region-of-interest, complete re-acquisition of data may be needed for a thorough analysis.
>
> It would therefore be desirable to have a new method and apparatus that allows coverage of large FOV without slab-boundary artifacts in the resulting concatenated images.
> Applicant's Specification, paragraph 4 and 5.

Therefore, the very purpose of Applicant's invention is to overcome the non-ideal images that may result from concatenating images derived from the use of multiple FOVs to image large regions of interest. That is, the current invention seeks to overcome the limitations that result from systems such as Wang et al.

Rejections under §102:

Regarding the rejection of claim 1 as anticipated by Wang et al., the Examiner states that "the examiner considers the desired large region of interest to be equivalent to applicant's desired FOV...because in applicant's specification the 'desired field of view' is the total area that applicant desires to image." However, the Examiner's statement is both incorrect and unsupported. First, Applicant's specification *does not* define "desired field of view," or "desired FOV," as the total area that Applicant desires to image. As previously stated, it is incorrect to equate "region of interest" with FOV. Claim 1, in part, specifically calls for "an FOV spanning an area greater than a predefined optimal imaging area of the medical image scanner." Therefore, Applicant does not claim, Applicant's Specification does not define, and the plain meaning that one of ordinary skill in the art would give the terms, does not support that "FOV" is equivalent to "region of interest." Simply, "FOV" is not equivalent to "region of interest." Therefore, it is incorrect and unsupported for the Examiner to contend that such terms are equivalent.

The Examiner also states that "the 'desired region of interest' in the Wang reference is 'larger than an optimal imaging volume' (i.e. the series of smaller fields of view which collectively span the desired large region of interest, are considered by the examiner to constitute smaller 'optimal imaging volumes')." Regardless of the validity of the Examiner's statement, Applicant does not claim a desired region of interest that is

larger than an optimal imaging volume. Applicant claims a desired FOV larger than an optimal imaging volume. Again, "FOV" is not equivalent to "region of interest." The Examiner is reminded that the specific language of the claim must be examined and the Examiner is not permitted to impute limitations or claim elements into the claims. Furthermore, claim language must be interpreted in light of Applicant's own Specification and if Applicant did not define the term, claim language must be given plain meaning as would be interpreted by one of ordinary skill in the art. MPEP § 2111.01.

The Examiner also asserts that "Wang teaches and suggests 'selecting a slab thickness in a first direction that is smaller than the desired FOV (i.e. the 'desired large region of interest')." Again, the Examiner is reminded that FOV is not equivalent to region of interest. However, the Examiner's assertion now equates slab thickness and FOV. This is also incorrect. As stated, Wang et al. teaches the use of multiple FOVs to image the region of interest and then registers the image data (see claim 1 of Wang et al.). Wang et al. does not teach the use of "slabs" as explicitly defined in Applicant's Specification and called for in the claims, within the FOVs. Applicant's specification is explicit that "[t]he desired FOV 110 is substantially larger than the optimal imaging area 108, which is generally larger than a selected slab thickness 112." *See* paragraph 27 of Applicant's Specification.

The Examiner also asserts that "Wang *suggests* 'acquiring full encoding data in the first direction for a subset of another two direction;'" Emphasis added. However, the Examiner is reminded that, by definition, a rejection under § 102(b) must "describe" each and every element of the claim, not "suggest" it. Therefore, whether or not Wang et al. makes such a suggestion is irrelevant because mere suggestion is not sufficient to sustain a §102 rejection. Nevertheless, Wang et al. teaches collecting all k-space data for a FOV and then moving the table. *See* Col. 6, lns. 52-65 and Fig. 6. Wang et al. teaches that "NMR data is acquired for a complete image." Col. 6, lns. 58-59. That is, Wang et al. teaches that "[p]hase encodings are stepped...until all k-space has been sampled." Col. 6, lns. 62-65 Therefore, Wang et al. does not teach "acquiring full encoding data in the first direction for a subset of another two directions," as called for in claim 1. The Examiner's

attention is also directed to column 6, lines 66 — column 7, line 11 where Wang et al. specifically describes the acquisition of one image at a time, then moving the table, acquiring another image, then moving the table, etc. Wang et al. then explicitly states that "the acquired field of view images are registered with each other and combined to form a single image of the much larger region of interest." This is in contrast to the present claims, such as claim 1 that calls for a method of imaging large volumes *without resulting slab-boundary artifacts*. As described herein, the elements/limitations in the body of this claim are directed to that process, which is not taught, or suggested by Wang et al.

The Examiner also contends that Wang et al. "teaches and suggests 'step-wise moving one of the optimal imaging volume and an imaging object;'...and Wang teaches and suggests 'acquiring another set of MR data between each step-wise movement until the desired FOV...is imaged.'" The Examiner provides a laundry list of pin-point citations, however, all are unsupportive because Wang et al. does not teach step-wise moving one of the optimal imaging volume and an imaging object or acquiring another set of MR data between each step-wise movement until the desired FOV is imaged. Simply, Wang et al. teaches step-wise movement of the patient table between multiple FOV acquisitions until the region of interest is imaged. *See* Fig. 6 of Wang et al. and Component 376 of Fig. 6 of Wang et al. Again, "FOV" is not equivalent to "region of interest." Therefore, Wang et al. teaches multiple FOVs and step-wise movement therebetween while claim 1, in part, calls for performing the step-wise movement within the desired FOV "until the desired FOV is imaged." Claim 1 specifically calls for an acquisition of MR data that includes "full encoding data in the first direction for a subset of another two directions that occurs between each stepwise movement of the table. Wang et al. collects all the k-space data that it will ever collect for each sub-FOV before moving the table as clearly illustrated in Fig. 6 of Wang et al. that may be contrasted to that shown in the present Fig. 4.

Wang et al. teaches a method of imaging a large region of interest using multiple FOVs and stepping the table between the FOVs. However, the method taught by Wang et al. will result in slab-boundary artifacts. Claim 1, in part, calls for "[a] method of

FOV larger than an optimal imaging volume of an MR scanner. Wang et al. teaches directly away from this by stating that the "large region of interest" is imaged by using "a series of smaller fields" or FOVs, "which collectively span the large region of interest." Col. 2, lns 42-44. Furthermore, claim 1, in part, calls for "step-wise moving one of the optimal imaging volume and an imaging object; and acquiring another set of MR data between each step-wise movement until the desired FOV is imaged." Wang et al. teaches directly away from this by stating that "[a]t the completion of the first image acquisition the pulse control module 121 commands the patient positioning system 134 to move the table 256 to the next station to align the next field of view." Col. 6, ln. 66 to Col. 7, ln. 2 "Another image is then acquired at 372 and 374" and [t]his sequence continues until the last field of view in the scan has be acquired." Col. 7, lns. 5-6.

For all of the above reasons, Applicant believes claim 1 is clearly patentably distinct over Wang et al. Regarding claims 2-14, Applicant notes that the Examiner improperly interprets claim language by improperly equating distinct terminology. However, Applicant believes such to be sufficiently addressed with respect to claim 1 and trusts that the Examiner will better understand the invention in light of the aforementioned explanation. As such, Applicant herein incorporates the relevant remarks with respect to claim 1. Furthermore, Applicant believes claims 2-17 are in condition for allowance pursuant to the chain of dependency and, therefore, does not believe additional remarks are necessary.

The Examiner next rejected claim 18 stating that "[t]he Wang reference *suggests* that the computer controlled components of the MRI apparatus are" programmed to complete the steps called for in claim 18. Emphasis added. As previously stated, a rejection under § 102(b) must "describe" each and every element of the claim. Suggestion does not meet this burden. Nonetheless, the Examiner justifies this broad assertion on "the same reasons that were given in the rejection of claim 1, since these limitations are just equivalent repetitions of the limitation of claim 1, repeated in a format for a computer program." The Examiner is reminded that under MPEP § 2131, the Examiner must show that the art of reference teaches each and every element of the claim. A recitation that the Examiner believes the claim to repeat the limitations of a

claim. A recitation that the Examiner believes the claim to repeat the limitations of a previous claim does not meet this burden. Nevertheless, Applicant has already shown the Examiner's rejection to be erroneously based on unsupported interpretations of distinct terminology. As such, Applicant incorporates those relevant remarks herein.

Furthermore, claim 18, in part, calls for receiving "input defining a desired FOV larger than an optimal imaging volume." As previously shown, Wang et al. teaches directly away from this by teaching that the "large region of interest" is imaged by using "a series of smaller fields" or FOVs, "which collectively span the large region of interest." Col. 2, lns 42-44. Additionally, claim 18, in part, calls for incrementing "the patient table while maintaining position of the fixed slab; and repeat[ing] the acquire and increment acts until an MR data set is acquired across the desired FOV." Again, Wang et al. makes no such teaching and as previously shown, the Examiner's citation to col. 5, lines 55-67 and col. 7, lines 1-22 does not support that position. That is, in those sections, Wang et al. teaches dividing the region of interest into multiple FOVs, translating the table between the FOVs, and once data from all the FOVs is acquired, the FOV images are "combined to form a single image of the much larger region of interest." Col. 7, lns. 1-22. This is not incrementing "the patient table while maintaining position of the fixed slab; and repeat[ing] the acquire and increment acts until an MR data set is acquired across the desired FOV." With reference to claim 18, Applicant claims a specific sequence in its computer to receive input..., define a fixed slab..., *acquire full MR data in a direction of table motion, defined as z-direction, for a selected k_x-k_y subset in the fixed slab, increment the patient table while maintaining position of the fixed slab, and repeating the acquisition and increment acts until an MR data set is acquired across the desired FOV to reconstruct an image of the FOV.* This series of acts creates a loop, when read together, is clearly not taught, or even suggested, by Wang et al.

The Examiner again states that "[t]he Wang reference *suggests* that the computer controlled components of the MRI apparatus are 'programmed to: ...acquire full MR data in a direction of table motion, defined as z-direction, for a selected k_x-k_y subset in the fixed slab.'" Emphasis added. While a mere suggestion is not sufficient to sustain a §102 rejection, what Wang et al. actually teaches, and suggests, is the collection of all k-space

data for an FOV and then moving the table. *See* Col. 6, lns. 52-65 and Fig. 6. That is, Wang et al. teaches that "NMR data is acquired for a complete image." Col. 6, lns. 58-59. Therefore, Wang et al. teaches that "[p]hase encodings are stepped...until all k-space has been sampled." Col. 6, lns. 62-65. Accordingly, claim 18 clearly defines over Wang et al. As such, Applicant believes claim 18, and claims 19-27 are in condition for allowance pursuant to the chain of dependency.

Regarding the rejection of claim 1 as being anticipated by Yoshitome, the Examiner has failed to understand a fundamental difference between that taught by the reference and that which is claimed. Claim 1, in part, calls for "exciting and encoding spins to acquire data that is restricted to the selected slab thickness." However, Yoshitome teaches directly away from this, stating "echo data K(i) is collected using a sequence with the same gradient and number of samples as when imaging the entire imaging range. Page 2, constitution paragraph. Simply, Yoshitome teaches imaging as if encoding the entire "imaging range larger than the imagable region." Page 2, constitution paragraph. Therefore, one of ordinary skill in the art will readily recognize that Yoshitome teaches directly away from "exciting and encoding spins to acquire data that is restricted to the selected slab thickness." Accordingly, Applicant believes claim 1 is patentably distinct over Yoshitome. Furthermore, Applicant believes claims 2-17 are in condition for allowance pursuant to the chain of dependency.

Regarding the rejection of claim 18, the Examiner states that Yoshitome "suggests that the computer controlled components of the MRI apparatus are 'programmed to: ...acquire full MR data in a direction of table motion, defined as z-direction, for a selected k_x-k_y subset in the fixed slab." The Examiner supports this assertion under "the same reasons that were already given in the rejection of claim 1." However, Applicant has shown claim 1 is allowable over Yoshitome. Yoshitome does not excite and encode spins to acquire data that is restricted to the selected slab thickness. Yoshitome uses a sequence with the same gradient and number of samples as when imaging the entire range. As such, Applicant herein incorporates those relevant remarks. Specifically, Yoshitome teaches imaging as if encoding the entire "imaging range larger than the imagable region." Page 2, constitution paragraph. Therefore, Yoshitome teaches directly

away from acquiring "full MR data in a direction of table motion, defined as z-direction, for a selected k_x-k_y subset in the fixed slab." Accordingly, Applicant believes claim 18 is patentably distinct over Yoshitome. Furthermore, Applicant believes claims 18-27 are in condition for allowance pursuant to the chain of dependency.

Rejections under §103:

Regarding the rejection of claim 28, the Examiner states that the "obviousness that apply to claims 1, 8, 18, 19 also apply to claim 28." However, claims 1, 8, 18, and 19 were rejected under § 102, not § 103. The Examiner is reminded that obviousness is not the proper standard for rejection under § 102. Therefore, the Examiner has not established any "obviousness" of claims 1, 8, 18, and 19. Accordingly, the Examiner has failed to support the rejection of claim 28.

The Examiner is further reminded that the burden of establishing a *prima facie* case of obviousness falls on the Examiner. *Ex parte Wolters and Kuypers*, 214 U.S.P.Q. 735 (PTO Bd. App. 1979). Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention absent some teaching or suggestion supporting the combination. *ACS Hospital Systems, Inc. v. Montefiore Hospital*, 732 F.2d 1572, 1577, 221 U.S.P.Q. 929, 933 (Fed. Cir. 1984). Accordingly, to establish a *prima facie* case, the Examiner must not only show that the combination includes each and every element of the claimed invention, but also provide "a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references." Ex parte Clapp, 227 USPQ 972, 973 (Bd. Pat. App. & Interf. 1985). That is, "[o]bviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art." MPEP §2143.01. "The fact that references can be combined or modified is not sufficient to establish *prima facie* obviousness." Id. When prior art references require a selected combination to render obvious a subsequent invention, there must be some reason for the combination other than the hindsight gained from the invention itself, i.e., something in the prior art as a whole must suggest the desirability,

and thus thc obviousness, of making the combination. *Uniroyal Inc. v. Rudkin-Wiley Corp.*, 837 F.2d 1044, 5 U.S.P.Q.2d 1434 (Fcd. Cir. 1988). Therefore, the Examiner has clearly not cstablished a *prima facie* case of obviousness.

Neverthelcss, Applicant has previously shown the rejection of claims 1, 8, 18, and 19 is improper. Specifically, Yoshitome teaches imaging as if encoding the entire "imaging range larger than the imagablc region." Page 2, constitution paragraph. That is, Yoshitome teaches that "echo data is collected using a sequence with thc same gradient and number of samples as when imaging the entirety of the above imaging rangc." Page 5, paragraph 0006. Thereforc, Yoshitome teaches dirccly away from applying "magnetic filed gradients to encode the region in the first direction" and acquiring "3D k-space data in the first direction for a subset of a second and third direction." That is, Yoshitome teaches imaging as if encoding the entire "imaging range larger then thc imagable region." Page 2, constitution paragraph. Therefore, Applicant bclieves claim 28 is patcntably distinct from the art of record.

Regarding thc Examiner's rejection of claim 10 under 35 U.S.C. §103(a) as being unpatentable over Yoshitome (No. H5-95927), claims 9, 13-17, 19, 20, 22, 29-30, 32-35, and 37 under 35 U.S.C. §103(a) as being unpatentable over Yoshitome (H6-311977), and claim 31 under 35 U.S.C. §103(a) as being unpatentable over Yoshitome (H6-311977) in view of Wang et al. under 35 U.S.C. §103(a), Applicant respectfully disagrees with thc Examiner with respect to what the art shows. However, in light of cach of the aforementioncd claims depending from what is believcd an otherwise allowable claim, Applicant does not believe additional rcmarks are necessary and therefore requests allowance for claims 9, 10, 13-17, 19, 20, 22, 29, 30-35, 37 pursuant to the chain of dependency.

Therefore, in light of the foregoing, Applicant respectfully believes that thc prescnt application is in condition for allowance. As a result, Applicant rcspectfully requests timely issuance of a Notice of Allowance for claims 1-38.